



Newsletter

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Director's Note

The Institute of Ecosystem Studies has a strong commitment to education, and extends its education programs to all members of the community. Primary school children benefit from outdoor programs and the Eco-Inquiry curriculum. High school students do their own acid rain research in the Outdoor Science Center. College students participate in Research Experiences for Undergraduates, described in the last issue of the Newsletter, and graduate students work with IES advisors on research for advanced degrees.

Public offerings, such as the Sunday Ecology Program and other visitor activities, involve the public in the excitement and relevance of ecosystem research. Publications like *Discoveries in Ecology* keep interested readers up to date on our research progress. And, last but not least, the IES Continuing Education Program teaches practical skills from an ecological perspective to a rapidly growing audience of laypersons and professionals. This program has evolved considerably over the past 5 years, as detailed in our cover story.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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Continuing Education: An Ecological Approach

A family has just moved into a new home and wants to create a garden that emulates the natural landscape A team of engineers needs to know how to restore a wetland damaged by nearby development A high school biology teacher wants to learn how to grow vegetables organically, so that he may pass the information on to his students A young woman, employed for five years by a landscaping firm, decides to go into business for herself A retired couple loves deer, but hopes to learn how to keep the animals from browsing on rosebushes in the back yard.

All these individuals will find the information they are looking for in the IES Continuing Education Program

A principal goal of the Institute of Ecosystem Studies is to provide education and broaden public awareness about the importance of ecological relationships to human welfare. One vehicle for accomplishing this goal is the IES Continuing Education Program. Over the past several years, under the leadership of IES head of education Dr. Alan Berkowitz and program leader Jacqueline Gantnier, this program has been evaluated and expanded. Its purpose is to promote an ecological approach to horticulture, landscape design and land management; to teach practical skills from an ecological point of view; and to increase knowledge of environmental issues.

Courses, workshops and ecological excursions are offered each year during fall, winter and spring semesters. In the 1988-89 academic year, over 1000 people from New York, Connecticut and Massachusetts enrolled in classes and workshops, or participated in excursions. A number of IES Continuing Education Program students take classes or attend workshops solely for personal enjoyment or enrichment. The majority, however, is enrolled in professional-level landscape design or

gardening certificate programs, and is receiving training helpful in career advancement or in making a career change. Course instructors are landscape architects, landscape designers, horticulturists, landscape consultants and naturalists who are selected to teach at the Institute because of their expertise in relevant areas. IES scientists and educators provide ecological guidance during curriculum development, and often give lectures, serve as workshop presenters and lead ecological excursions.

What's new for 1990 in the IES Continuing Education Program? *Gardening with Ornamental Grasses* and *Introduction to Rock Gardening* are two new electives in the Gardening Certificate Program. Additions to the workshop series include *Basic Residential Landscape Design*, teaching skills needed to achieve an environmentally responsible home landscape, and *Habitats for Conservation*, presenting an ecological overview of biologically significant habitat types in the Hudson Valley. Under the category of ecological excursions, *Birds and Whales at Cape Cod Bay* is a first-time offering.

In all, twenty-nine courses, six workshops and five ecological excursions are scheduled for the January - May period. The Winter 1990 Semester begins the week of January 22nd and the Spring Semester begins the week of April 2nd. Refer to the Continuing Education Program catalogue for a complete list of offerings.



IES Continuing Education Program instructor Judy Glatstein, second from the right, points out details of a landscaping plan to students in her Naturalistic Garden Design class.

The Arboretum's Deer Hunt

How can an environmental organization permit deer hunting on its property? That question, often asked of Institute of Ecosystem Studies staff, is answered quite simply: as an environmentally aware organization, IES should permit it. But this answer can evoke strong reactions—and not long ago I might have been among those in opposition. While researching an article to explain the Arboretum's controlled deer hunt to IES Newsletter readers, however, I found my reactions moderating somewhat.

In order to understand the rationale for a controlled deer hunt, one must appreciate the conditions required for a balanced ecosystem. Populations within ecosystems fluctuate. These fluctuations in a healthy ecosystem result from naturally occurring interrelationships, including those between organism and habitat and between prey and predator. Historically, white-tailed deer populations were kept in balance by the vast areas of mature forests that limited favorable habitat, by predators, and by year-round hunting by Native Americans. (Colonial-era estimates indicate that approximately 2.3 million Native Americans harvested from 4.6 to 6.4 million deer annually nationwide.) In the Northeast during the 1800s, massive land-use changes in the form of clear-cutting of forests, coupled with market hunting, nearly eliminated white-tailed deer populations. More recently, laws have been passed to protect deer from exploitation, and the patchwork of fields and thickets created by forest regrowth and abandoned agricultural lands now provides ideal feeding conditions and habitat for deer. Consequently, their numbers have increased dramatically.

Deer population dynamics are such that under ideal conditions there is a theoretical potential for the numbers to double each year. Uncontrolled deer populations can lead to habitat degradation and a resulting decline in other animal species—the number of songbirds will drop, for example, in a forest whose understory has been heavily browsed. As deer herds grow, crop loss and human injury (through highway collisions) increase, as does suffering and death of the deer themselves when weaker members of the herd fail to compete for decreasing food resources.

At the Mary Flagler Cary Arboretum, an integrated management approach maintains the deer population at a level that does not compromise competing land uses—plant ecology research, the Perennial Garden and

the other plant collections—and that attempts to keep the herd stable (where mortality equals recruitment, or births). Wildlife biologist Raymond Winchcombe, IES manager of field research facilities, combines the use of repellents and deer fencing with routine monitoring and a controlled deer hunt to achieve a balanced ecosystem: a thriving plant community; a healthy, adequately-nourished deer herd; and the full complement of other field and forest creatures sharing the landscape.

Deer repellents are commercially available, and some have been tested at the Arboretum. Michael Fargione, a former IES staff member now at the Hudson Valley Laboratory in Highland, New York, is currently measuring the deterrent effects of some common soaps, using a site at the Arboretum for his study. More obvious to Arboretum visitors is the use of fencing to protect plantings at the Plant Science Building, research field, greenhouse and perennial garden (seasonal). To be as effective as possible, deer fences must be complete enclosures built to the proper specifications, and some should be electrified. (Other methods of deer population management have been tried elsewhere, among them trap-and-transfer and the use of anti-fertility agents. Such controls have not proved feasible in larger areas, however, and have resulted in high mortality rates: 60% of deer that are trapped and moved to new locations, for example, do not survive their first winter.)

While repellents and fences protect plants from browsing, the controlled deer hunt is the Arboretum's major effort to maintain a stable population. This effort began when the Arboretum was established in the early 1970s; at that time, more than 200 hunters roamed the property each season. In 1976, Mr. Winchcombe and wildlife ecologist Jay McAninch began to organize the operation more systematically, holding an orientation meeting for all who wished to hunt at the Arboretum. That year the number of hunters dropped to 90. Over the next few years the rules of the hunt evolved, and today hunters must apply for an Arboretum permit well in advance of the season, have a state-issued deer management permit, attend an orientation meeting and pass a shooting proficiency test.

The shooting test helps reduce the chances that an animal will suffer due to a hit by an off-target bullet. There is now more evidence of this test's usefulness. In June 1989, Mr. Winchcombe sent a list of 44

questions to each of 55 hunters in an effort to learn about problems or concerns, to hear suggestions and to find out how they felt about the IES hunt rules and regulations. Survey question #43 was "Why do you hunt on the Arboretum?" The most frequent response, cited by 93% of those polled, was safety.

Between 55 and 60 people are given permission to hunt each year on the 1,924 acre Arboretum. Before hunting season begins, Ray Winchcombe and a crew of volunteers—I joined them one brisk fall evening several years ago—look at population trends on the Arboretum. Using their very sharp eyes and traveling a fixed route, they note ratios of does to bucks and does to fawns. Any significant yearly changes in these ratios may indicate an increasing or decreasing deer population. Generally, to maintain a stable population, approximately 40% of each year's harvest should be adult females.

The emphasis of the Arboretum hunt is on population control rather than on recreation. Hunters understand that they must provide a service in exchange for the opportunity to hunt here, and that they are therefore required to participate in the full deer management program. They are expected to harvest an adult female on a somewhat regular basis, in addition to their one buck, and to put forth a good effort over a minimal number of hours in an attempt to reach that goal. They are also required to bring their deer to the IES field laboratory where data including age, sex and dressed weight are collected. This information is added to a 15-year data base and used to monitor the physiological status of the Arboretum herd. In addition, this year Drs. Durland Fish and Thomas Daniels from New York Medical College collected ticks from the deer to contribute to their study of Lyme disease.

There will always be debate over hunting. In researching the Arboretum's controlled deer hunt, I began to understand its contribution to maintaining balance within the ecosystem. Perhaps IES Newsletter readers on either side of the debate will also move closer to an understanding that what is best for the whole might be best for its parts.

*Jill Cadwallader,
Editor, IES Newsletter*

Bacteria in the Stream

In a healthy Temperate Zone stream there is a world of living organisms under rocks, in the dead leaves, and in the stream sediments. These organisms range in size from 7.5-centimeter (3-inch) crayfish, down to isopods and amphipods (crustaceans that are rarely more than 1.3 centimeters (0.5 inches) in length), to insect larvae and nymphs, to species of worms, and finally to microscopic animals and plants. Most of these organisms are scavengers and detritivores, the latter being creatures that feed on particles of organic matter left behind by the scavengers. Eventually organic matter is broken down all the way to its simplest chemical components—a very important process that keeps streams from quickly being clogged by dead animals and plants. The final breakdown products are recycled as nutrients for primary production, providing the building blocks for new life . . . microbes, single-celled plants, microscopic animals, and finally fish.

Bacteria, single-celled micro-organisms, are the ultimate decomposers, producing simple organic and inorganic compounds from organic matter. Some types of bacteria, in the presence of oxygen, convert compounds such as carbohydrates (sugars, starches and cellulose) into carbon dioxide (CO_2) and water. Because of their role in the breakdown of this organic carbon, bacteria are important to consider when trying to understand how food webs work in streams, either for the growth of the fish population or for the elimination of incoming foreign compounds from human activity.

One scientist who is making use of the role played by bacteria is Dr. Dominique A.J. Fontvieille from Chambéry University near Lyon, France. A limnologist, he studies fresh water systems; his particular interest is the relationship between bacteria, organic carbon, and stream ecology. Dr. Fontvieille spent the past year at the Institute of Ecosystem Studies, investigating this relationship in the East Branch of Wappinger Creek and in Hubbard Brook, in New Hampshire's White Mountains.

What sparked his curiosity? In successful science, there is a need to be curious, and Dr. Fontvieille became curious about ecological relationships in streams when, as a graduate student, he did his Ph.D.

thesis work on a section of stream immediately below a pigsty. There was a tremendous input of organic carbon from the pigs' wastes, and the bacteria began breaking it down immediately. Dr. Fontvieille measured CO_2 production by placing bell jars on the stream sediment at a number of shallow spots downstream from the sty. Within the bell jars were sediment, water and air, and the air was circulated through an infrared spectrophotometer that detected and recorded the amount of CO_2 that was released by bacteria. The data showed that by the time the water had traveled eight hours downstream the wastes had been degraded into harmless by-products, and the quality of the stream water was approaching normal. This remarkable purification was the result of bacterial work in the



Dr. Dominique Fontvieille uses an oxygen analyzer to measure metabolic activity in the East Branch of Wappinger Creek. The types of bacteria that Dr. Fontvieille studies in aquatic ecosystems take in oxygen and release carbon dioxide as they break down organic carbon in the sediments. Changes in levels of oxygen dissolved in the stream water, as recorded by the oxygen analyzer, show the level of bacterial activity.

sediments; these microscopic organisms were accomplishing "sewage treatment."

Dr. Fontvieille's curiosity continues to grow as he monitors bacterial activity in different types of streams and applies his findings to practical concerns. For example: What are the effects of terrestrial inputs on streams? House building, the creation of a beach, development of a recreation area, construction of a parking lot . . . all could have effects on neighboring freshwater bodies. An understanding of how terrestrial activity controls stream sediment activity, and how the "ultimate decomposers" cope with environmental disturbance, is useful to both land managers and developers.

Dr. Fontvieille is also using his research findings to monitor the effectiveness of sewage treatment plants. He was the first to apply to aquatic systems a test that formerly had been restricted to terrestrial environments. This test, using FDA (fluorescein di-acetate), a colorless chemical that turns fluorescent green when exposed to enzymes produced by bacteria, is inexpensive, quick and safe (as opposed to radioactive tracing). Bacteria are used in sewage treatment plant reactors to break down waste materials to their harmless components. If something should cause the bacteria in the reactors to die suddenly, water would pass through the system untreated. By using the FDA test in reactors to check for bacterial activity, plant supervisors learn immediately if wastes are not

being treated properly. Similar kinds of tests are done in heavily polluted streams.

In his work in the East Branch of Wappinger Creek and Hubbard Brook, Dr. Fontvieille compared different methods for measuring the metabolic activity of bacteria in stream sediment, and also compared different points along the stream. When the measurements showed changes in bacterial activity, it meant that the input of organic carbon—either its amount or its quality—was changing. In an analogy to humans, who must expend more energy to digest protein than to digest carbohydrate, bacteria find carbohydrates from cellulose more difficult to break down than those from algae. Among the leaf types, birch leaves are more easily degraded than maple leaves. A measurement of the bacterial metabolism can provide a good clue to the source of organic material the organisms are using.

Dr. Fontvieille's research at IES was supported by research grants from NATO and the Franco-American Commission. The NATO grant was part of a program aimed at helping international cooperation, and Dr. Fontvieille plans to extend this cooperation by continuing to collaborate with IES scientists. He hopes to send students from Chambéry University to IES, and is also interested in collaborating with aquatic ecologist Dr. Stuart Findlay—his initial contact at the Institute—on further studies of relationships between terrestrial and aquatic environments.

Environmental Lectures - Winter 1990

Earth in Rebellion is a new lecture series sponsored by The New York Botanical Garden and dedicated to the principles of conservation and responsible environmental education. The speakers are internationally recognized and respected leaders in environmental policy and research:

Jan. 17: **The Future of Environmental Policy**, by William K. Reilly, Administrator, U.S. Environmental Protection Agency

Jan. 31: **Tropical Rainforests: The Burning Question**, by Dr. Thomas E. Lovejoy, Assistant Secretary for External Affairs, Smithsonian Institution

Feb. 28: **Acid Rain: Science and Politics**, by Dr. Gene E. Likens, Director, Institute of Ecosystem Studies, and Vice President, The New York Botanical Garden

Mar. 7: **Mass Extinction of Species: Why We Should Be Concerned, What We Can Do**, by Dr. Norman Myers, Wildlife ecologist, author, environmentalist

Mar. 21: **Warming of the Earth: What Shall We Do?**, by Dr. George M. Woodwell, Director, Woods Hole Research Center

All lectures will be held at Manufacturers Hanover Corporation World Headquarters in New York City, from 6 - 7:15 p.m. Pre-registration is required. Please call The New York Botanical Garden Education Department at (212) 220-8747 for information.

Winter Calendar

CONTINUING EDUCATION PROGRAM

Winter semester classes and workshops in landscape design, gardening and botany will begin in the third week of January, and Winter/Spring Continuing Education Program catalogues were mailed early in December. If you are not on our mailing list, stop by the Gifford House or call the number below to get a copy.

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A. For walks, dress according to the weather, with warm, waterproof footwear. Please call (914) 677-5359 to confirm the day's topic:

Jan. 7: **A Simple Sample: Ecosystem Science from Start to Finish**, a slide presentation and lab tour by Kathleen Weathers.

Jan. 21: **Weeds in Winter**, a walk and indoor work with plant keys, led by Kass Hogan.

Feb. 4: **Sizes and Shapes Along the Seashore: How Animals "Fit" Into Their Environment**, a slide presentation by Dr. Thomas Bianchi.

Feb. 17: — no program —

Mar. 4: **Ecology and Earth History in Our Grandest Canyon**, a slide presentation by Dr. Alan Berkowitz.

Mar. 18: **The Ecology of the Sugar Maple** *In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the program.*

IES SEMINARS

The Institute's weekly program of scientific seminars features presentations by visiting scientists or Institute staff. All seminars are held in the Plant Science Building on Fridays at 3:30 p.m. Admission is free.

Jan. 12: **Limnetic Food Webs: Experimental Tests of Independence of Nutrient and Predator Controls**, by Dr. Stephen Threlkeld, Fordham University.

Jan. 19: **Meta-Population Processes in Dynamic, Patchy Landscapes**, by Dr. H.G. Merriam, Carleton Univ., Ottawa.

Jan. 26: **Nature Conservation in British Woodlands**, by Dr. G. Peterken, Nature Conservancy Council, U.K.

Feb. 2: Topic: Macrophytes.

Speaker: Dr. R.G. Wetzel.

Feb. 9: **Tropical Forests, Coral Reefs, and the Global Carbon Dioxide Problem**, by Dr.

Thomas J. Goreau, Discovery Bay Marine Laboratory, Univ. of the West Indies, Jamaica.

Feb. 16: **Responses of Microtine Rodent Populations to Food Quality**, by Dr. George Batzli, Univ. of Illinois.

Feb. 23: **Remote Detection of Forest Damage**, by Dr. Barry Rock, Univ. of New Hampshire.

Mar. 2: **Forest Disturbance and Organic Matter in Streams - or How the Chestnut Blight Saved Coweeta**, by Dr. Jackson Webster, Virginia Polytechnic Institute and State Univ.

Mar. 9: **Ensemble Dynamics: Local Extinction and Persistence of a Parasitoid and Its Host**, by Dr. Donald R. Strong, Florida State University.

GREENHOUSE

... a tropical island in a sea of winter. There is no admission fee, but visitors should first stop at the Gifford House for a free permit.

GIFT SHOP

Senior Citizens Days: 10% discount for senior citizens each Wednesday (sale items excluded). **Annual Holiday Clearance Sale**, during all of January. 20% off on gifts and 10% discount on books. Holiday items and candles reduced 50%.

ARBORETUM HOURS

(Winter Hours: October 1 - April 30; closed on public holidays)

The Arboretum is open Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m.

The Gift and Plant Shop is open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. (closed weekdays from 1 - 1:30 p.m.).

All visitors must get a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

For more information, call (914) 677-5359 weekdays from 8:30-4:30

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